Memorandum
U.S. Department of Transportation
Federal Aviation Administration

Subject: **ACTION**: Federal Aviation Administration (FAA) Engine and Propeller Directorate Policy Regarding Time Limited Dispatch (TLD) Of Engines Fitted With Full Authority Digital Engine Control (FADEC) Systems

Date: October 28, 1993

From: Manager, Engine and Propeller Directorate, ANE-100

Reply to Attn. of: Cos Bosco, ANE-110
781-238-7118

To: Manager, Small Airplane Directorate, ACE-100
Manager, Transport Airport Directorate, ANM-100
Manager, Rotorcraft Directorate, ASW-100
Manager, Aircraft Engineering Division, AIR-100
Managers, Aircraft Certification Offices

The purpose of this memorandum is to state the present policy guidelines to assure uniformity of TLD dispatch policy that is applied to engines fitted with FADEC systems. An attachment to this memorandum defines the Engine and Propeller Directorate policy regarding time limited dispatch of engines fitted with FADEC systems.

The objective of the TLD approach is to preserve suitable FADEC system integrity while minimizing dispatch delays and cancellations caused by the system. The control system may be allowed to continue to operate with faults present, providing the resultant system operation and reliability are adequate, and operating exposure in this less redundant state is appropriately limited. The definition of the dispatchable configurations in terms of the faults and with associated dispatch intervals will be an engine data sheet limit. This becomes a part of the Type Design for the subject engines. A statistical analysis is submitted by the applicant that substantiates the reliability of the proposed configuration with faults for the associated dispatch intervals.

After a series of meetings in 1988 and 1989, the FAA and industry developed guidelines for TLD. Using these guidelines, dispatchable configurations for FADEC systems could be defined by applicants that would meet FAA airworthiness requirements for a dispatch interval. These guidelines were included in an FAA document that came to be known in the industry as Draft 4 dated March 17,1989. Although the document was widely distributed throughout the industry and was informally used by the FAA and applicants as a policy document, it was never issued as the FAA TLD policy.

Recently, requests for changes to Draft 4 guidelines were received from engine, control and aircraft manufacturers. These changes included requests to extend the dispatchable intervals and to simplify the reporting system. These requests were based on the positive correlation between analysis and the in-service experience that has been accumulated on engines on which these TLD guidelines have been applied. This field service experience has been presented to the FAA as data to support the request for changes based on system maturity. The FAA is in agreement with most of the requested changes based upon the supporting data. However, these changes are not appropriate for entry level systems without the requisite field experience and supporting data. Therefore, in order to accommodate the requested changes, the FAA has defined guidelines for entry level systems and mature systems.

In addition, it has become evident to the FAA that several areas of TLD require clarification. Areas in need of clarification include the application of average fault exposure time to maintenance practices and definition of terms.

The attached policy document is a modification of Draft 4 to incorporate changes requested by industry, to clarify a number of areas by providing additional information and to provide a document useful to the FAA and industry that states the Engine and Propeller Directorate policy regarding time limited dispatch of engines fitted with FADEC systems.

Any proposed change to the attached stated policy must be coordinated with ANE-100 prior to any agreement with an applicant.

Original Signed By:
Jay J. Pardee
October 28, 1993

Attachment: Engine and Propeller Directorate Policy Regarding Time Limited Dispatch (TLD) of Engines Fitted With FADEC Systems

Copies to:
Deputy Director, Flight Standards Service, AFS-2
Manager, AFS-200
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Manager, Boston-AEG
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Manager, Missouri-Kansas City-AEG
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Manager, Seattle-AEG
ATTACHMENT I

THIS ATTACHMENT IS PART OF THE ENGINE AND PROPELLER DIRECTORATE POLICY LETTER DATED OCTOBER 28,1993 FOR TIME LIMITED DISPATCH OF ENGINES FITTED WITH FADEC SYSTEMS.

SUBJECT: FEDERAL AVIATION ADMINISTRATION (FAA) POLICY GUIDELINES FOR TIME LIMITED DISPATCH (TLD) OF ENGINES FITTED WITH FULL AUTHORITY DIGITAL ENGINE CONTROL (FADEC) SYSTEMS

1. PURPOSE. This document provides an acceptable means, but not the only means, for obtaining approval under Federal Aviation Regulations (FAR) Part 33 for time limited dispatch of engines with FADEC systems in a degraded redundancy condition.

2. SCOPE. This document provides policy guidelines for obtaining FAA approval of time limited dispatch of engines fitted with FADEC systems, when these systems are to be dispatched with faults for limited time intervals before maintenance action is performed. It is an objective of this document to define dispatch guidelines that will provide a system that meets the airworthiness requirements for both the engine and aircraft.

3. CANCELLATION. This document supersedes all previous FAA policy on time limited dispatch of engines fitted with FADEC systems.

4. RELATED FAR SECTIONS. Part 33; Sections 33.4, 33.19, 33.28 and 33.91(a), relevant sections of installed Parts 23, 25, 27 and 29 and Parts 121, 125 and 135; Section 121.303.

5. DEFINITIONS.

a. Average Fault Exposure Time. When an analysis using the full-up model is conducted, the average fault exposure time is equal to one-half of the dispatch interval of interest, since the fault can occur at the start or end of the dispatch interval.

b. Central Processor Unit (CPU). The main processor(s) within the electronic engine control that receives conditioned input data, processes and manipulates the data and provides output commands to control the engine in accordance with stored algorithms.

c. Condition Monitored Maintenance. In this document, this is a maintenance strategy that is based on repairing faults as they occur, but in most cases allowing a specified operating time from the time of fault before repair of the fault is required.

d. Cross-Channel Data Link (CCDL). Digital data link by which data between redundant channels is transferred between functionally redundant CPUs.

e. Dispatch Interval. Defines the maximum time interval approved by the FAA for dispatch with faults present in the system before corrective maintenance must be performed.

f. Entry Level System. A FADEC system that has not reached maturity as defined in this document.

g. FADEC Family. Various FADEC systems can be considered to be a FADEC family when the electronic engine controls are related because of an overwhelming majority of parts are common and when the design and manufacturing technology is similar and when the engine installation is similar.

h. FADEC System. The FADEC system controls the operation of the engine over the entire operating range, usually from engine start to maximum power or thrust. The FADEC system consists of the electronic engine control (EEC), fuel metering unit (hydromechanical control), sensors, actuators, valves, alternator and interconnecting electrical harnesses. In some installations the system may include propeller control or reverser functions.

i. Fleet-Wide Average Loss of Thrust Control (LOTC) Rate. Defined as the "time weighted LOTC rate" of the FADEC system in all modes of operation and dispatch configurations. When in-service data is available, it is the total number of LOTC events of a family of FADEC systems divided by the total number of flight hours for the FADEC family.

j. Hours. In this document, hours refers to engine flight hours.

k. In-Flight Shutdown (IFSD). An engine ceases to function in flight and is shutdown, whether self-induced, crew initiated or caused by some other external influences. (IFSD caused by the FADEC system is considered an LOTC event.)

l. Loss of Thrust Control (LOTC). Loss of ability to modulate power or thrust from ground idle to 90% maximum power or thrust.

m. LOTC Rolling Average. The sum of LOTC events for a given period divided by the in-service hours for the same given period as in a three month period to give a three-month rolling average.

n. Maintenance Interval. In this document, this is a scheduled maintenance interval such as a condition monitored interval or an aircraft maintenance letter check, e.g., "A" check.

o. Mature Systems. A FADEC system reaches maturity as defined in this document after 250,000 hours of in-service operation in the particular installation or equivalent. In addition, data must be provided to demonstrate that the FADEC system has achieved a stable in-service LOTC rate that is consistent with the analysis on which TLD approval is based.

p. Redundant. An alternate, backup, equivalent method for providing a parameter or function so that the parameter or function can be provided even though one of the sources of the parameter or function is lost.

q. Uncovered Fault. A faulted parameter or function of the FADEC system that cannot be provided by another means.

6. DISCUSSION. The objective of the TLD approach is to preserve suitable FADEC system integrity while minimizing dispatch delays and cancellations caused by the system. The FADEC system may be allowed to continue to operate with faults present, providing the resultant system operation and reliability are adequate, and operating exposure in this degraded state is appropriately limited. A statistical analysis is submitted by the applicant that substantiates the reliability of the proposed faulted configuration for the associated dispatch intervals. Faults that define dispatchable configurations in terms of the faults, usually degraded redundancy, and with associated dispatch intervals, are tabulated in the statistical analysis report. The report is referenced on the engine Type Certificate Data Sheet (TCDS) and is then considered to be an engine data sheet limit. This becomes a part of the type certificate for the subject engine.

In applying TLD for use on the aircraft, engine and aircraft manufacturers and the FAA agreed to categorize the FADEC system faults into categories defined as no dispatch, short time dispatch and long time dispatch based upon the TLD policy guidelines. The engine manufacturer is required to provide data from the FADEC system to the aircraft that places the faults that define the dispatchable configurations into one of the three categories discussed in this document. Dispatch and maintenance decisions are then made based on the dispatch categories.

Because unpredicted factors may invalidate the analysis, a reporting system is instituted that compares service experience with the reliability levels used and/or computed in the statistical analysis. In addition, this reporting system is used to support future applications for changing dispatch time intervals.

The FAA Engine and Propeller Directorate policy has been to certify only those engines that can be certified in the aircraft installation. Therefore, the TLD engine guidelines have been established to address aircraft installation requirements as well as the engine requirements. However, it is recognized that final determination of the aircraft certification issues are made by the cognizant Aircraft Certification Office (ACO) and the guidelines contained in this document are not intended to restrict the ACO from imposing more stringent TLD requirements. The airframer may be required to demonstrate that up to a ten(10) percent thrust loss, as allowed in the definition of LOTC, does not adversely impact aircraft safety. Furthermore, any TLD limitations which are found to be incompatible with aircraft certification or operational approvals will be resolved within the FAA and the engine type certificate may be amended if appropriate.

a. Background. Dispatch criteria for early FADEC systems in revenue service was determined by selection criteria used for the established Master Minimum Equipment List (MMEL). Because of the complexity of the FADEC systems, it was difficult to consider the various failure combinations and the consequences of dispatch for those cases where there was no supporting safety analysis or field experience on which to base a dispatch decision. Therefore, this resulted in a somewhat limited dispatch criteria which, in some cases, had a more negative impact on the aircraft delay and cancellation performance than might result from an analysis performed according to these guidelines.

Aircraft and engine manufacturers recognized that the redundancy features and reliability of the FADEC systems could provide a means for improving aircraft delay and cancellation performance by dispatching with faults in redundant systems. The dispatchable configurations would need to meet the engine and aircraft continued airworthiness requirements and demonstrate that the use of dispatch configurations was safe over the dispatch interval. The manufacturers proposed TLD dispatch intervals for the dispatchable configurations that would enable aircraft to complete their regularly scheduled route structure. The FADEC faults could then be repaired on a normal maintenance schedule for the airplane.

In order to provide an analytical means for demonstrating the safety of the TLD and to provide a more technically sound basis for dispatch decisions, the aircraft and engine manufacturers applied an analytical technique, such as a Markov

Analysis or fault tree analysis, to the dispatch problem. The objective of the analysis was to demonstrate that dispatchable configurations would meet the FAA aircraft and engine continued airworthiness requirements.

The FAA, together with several aircraft and engine manufacturers involved in early FADEC system certification programs, developed guidelines for TLD. These early engines with FADEC systems have since accumulated sufficient acceptable field experience to be considered mature systems. Based on the positive correlation between the analysis and the in-service experience with TLD on these systems that supports the analysis conducted on these systems, the engine manufacturers have requested changes to the early guidelines. The requested changes include an increase in the dispatch intervals for short and long time dispatch and a simplified reporting system.

In order to accommodate these requests, the restructured guidelines in this document have been divided into entry level and mature systems. Entry level systems guidelines are essentially those in use prior to the issue of this document. They are somewhat more stringent than those to be applied to mature systems. After the appropriate amount of acceptable field experience has been accumulated, an entry level system may be reclassified by the FAA as mature. In addition, it is appropriate at this time to issue these guidelines on a more formal basis.

7. DISPATCH CRITERIA.

a. Each dispatchable configuration must:

(1) Meet all of the FAR Part 33 and applicable FAR Part 23, 25, 27, and 29 continued airworthiness requirements.

(2) Protect the engine operability/durability in accordance with the FAR Part 33 and applicable FAR Parts 23, 25, 27 and 29 requirements.

(3) Maintain the capability of critical engine limits and engine protection, e.g., overspeed.

(4) Maintain a means to provide necessary signals for engine operability and to identify system faults.

(5) Be supported by a statistical analysis for the proposed dispatch intervals.

(6) Not exceed a computed LOTC rate of 100 events per million hours.

(7) In any dispatchable configuration, no conceivable single failure of the FADEC system can prevent continued safe flight and landing of the aircraft, regardless of the probability of the event.

b. The applicant must show via a suitable analysis that the Fleet-Wide average reliability criteria or "average LOTC rate", which includes full-up as well as degraded system dispatches and uncovered faults, experiences less than 10 LOTC events per million hours.

c. In addition, the applicant must demonstrate by analysis and/or test that the dispatchable configurations continue to meet the environmental certification levels for the system, including high intensity radiated fields (HIRF) and lightning.

8. SYSTEM MODEL. The FADEC system model used in the statistical analysis must be approved by the FAA. The FADEC system includes, but is not limited to, the EEC, fuel metering unit (hydromechanical control), sensors, actuators, valves, alternator and interconnecting electrical harnesses.

It should be noted that in keeping with the directorate objective that the engine should be independent from aircraft, no LOTC credit should be taken in the system model for the use of aircraft power as backup power nor for data provided by the aircraft. Data provided from the aircraft may be used as a means to provide fault detection and isolation coverage.

In the statistical analysis, the applicants have used both the full-up and single-fault models to establish dispatch intervals. The full-up model is a model of the FADEC system taken with no faults and the analysis to determine LOTC is conducted with a system that has no faults at time equal zero. The single-fault model is a model of the FADEC system that is used in the analysis to determine LOTC, where the individual faults are sequentially assumed to exist in the model from time equal zero. The concept of average fault exposure time is discussed below. Its affect on maintenance strategies is discussed in Section 13.

a. Full-up Model. When the full-up model is used in the statistical analysis, the long time interval ("Y" value) that is determined can be made equal to the repeating maintenance interval, if this type of maintenance strategy is selected. When the full-up model is used, the average fault exposure time must be considered for the condition monitored maintenance strategy, since the fault can occur at any time within the dispatch interval. For example, a 500 hour repeating maintenance interval strategy that is supported by a statistical analysis which was used to determine that a long time interval of 500 hours is acceptable, would have a 250 hour average fault exposure time. However, with a condition monitored maintenance strategy, the fault is known at time equal zero and therefore the fault exposure time is the duration of the condition monitored interval. For example, a 250 hour condition monitored maintenance strategy would have a 250 hour fault exposure time. In the examples above, the fault exposure time is the same for the 500 hour repeating maintenance interval and the 250 hour condition monitored interval. Therefore, either maintenance strategy would be acceptable for systems approved for a 500 hour long time dispatch interval, provided the repeating maintenance interval was limited to 500 hours and the condition monitored maintenance interval was limited to 250 hours in this example.

b. Single-fault Model. When the single-fault model is used in the analysis to establish the dispatch interval, the fault being analyzed is considered to be faulted at t=0 of the dispatch interval. The statistical analysis is used to determine the failure rate for the system given the fault at t=0. Because the fault exists at t=0, the exposure time is equal to the entire interval and therefore, the average exposure time is not applicable for dispatch intervals computed using the single-fault model. This means that the reliability of the FADEC system is analyzed for the entire dispatch period of interest with the specific fault present. Therefore, the specific fault can be dispatched for the entire approved dispatch interval for either the repeating or condition monitored maintenance strategy.

9. UNCOVERED FAULTS. In the analysis, all uncovered faults must be assumed to lead to LOTC unless they can be shown not to directly result in an LOTC. The analysis must provide the rationale and substantiation for the failure rates that are used for uncovered faults in the analysis.

10. COMPONENT FAILURE RATES. The failure rates for components that are used in the analysis should be based upon those listed in MIL-HDBK-217 (through Rev E or later revision acceptable to the FAA) or equivalent document. Where the component failure rate is not listed in the handbook, the failure rate used in the analysis, should be supported by service experience or other equivalent supporting data. In-service data may be used in place of component handbook data when suitable data is available.

11. FLEET-WIDE AVERAGE LOTC RATE. The FAA requires that FADEC systems demonstrate an equivalent or better reliability than the hydromechanical technology of early systems. Based on available in-service data, the FAA determined that the IFSD rate attributable to hydromechanical controls was ten events per million hours. Therefore, the FAA criterion to demonstrate equivalence has been to demonstrate by analysis that the FADEC system would be chargeable for fewer than ten(10) LOTC per million flight hours. The analysis for TLD must demonstrate that the fleet-wide average LOTC rate continues to comply with this requirement for the proposed dispatch interval. The analysis to substantiate compliance with this equivalence criterion should be summarized in a graph. The ordinates of the graph should be in terms of fleet-wide average LOTC caused by the FADEC system per million hours versus the dispatch time interval in hours.

12. DISPATCH INTERVALS. The analysis that is submitted by the applicant must substantiate compliance with the guidelines defined herein for the desired dispatch configurations and dispatch intervals for the three categories, as applicable, that are defined in the succeeding paragraphs (see Figure 1). These three dispatch categories are classified as:

- no dispatch

- short time dispatch

- long time dispatch

The dispatch intervals for short and long time dispatch are defined in Figure 1. The dispatch intervals for entry level and mature engines have been separated in order to consider factors that are not included in the statistical analysis. The statistical analysis is based largely on electronic component data bases such as MIL-HDBK-217 (through Rev E or later revision acceptable to the FAA) that consider components to be mature. Because the components are considered to be mature, only random failures are considered in these data bases. Therefore, failures due to design, manufacturing and quality are not included in the data base.

Because system faults attributable to design, manufacturing, quality and maintenance errors are not covered by the statistical analysis, a factor related to service experience is introduced in this document. The experience factor is believed to provide a measure of correction for faults in the fleet resulting from latent design, manufacture and quality deficiencies and maintenance errors because these faults tend to be exposed and corrected as in-service time is accumulated. This experience factor is addressed by providing a more conservative criteria for dispatch intervals for entry level systems compared to mature systems even though the statistical analysis may support dispatch for a longer dispatch interval for entry level systems.

a. Entry Level Systems. The three dispatch categories for entry level systems are defined below.

(1) No Dispatch. The no dispatch configurations are defined as those where at least one of the following conditions exist:

(i) do not comply with engine (FAR 33) or the applicable aircraft continued airworthiness requirements (FAR 23, 25, 27 or 29);

(ii) have a complete loss of a critical resource or a critical function;

(iii) cannot provide engine overspeed or critical limit protection function;

(iv) have a degraded configuration that results in a computed LOTC occurrence rate of greater than 100 per million hours.

(2) Short Time Dispatch. Short time dispatch configurations require repair within an FAA approved interval, currently defined as a maximum of 150 hours or ten(10) calendar days, whichever occurs first. (For applications where annual engine in-service time is limited to several hundreds of hours, the ten(10) calendar days may not be an appropriate time and in these cases the applicant should discuss an alternative with the TCHO.) Short time dispatch configurations are defined as those that do not fall into the no dispatch category and where at least one of the following conditions exist:

(i) fault(s) has occurred that causes the FADEC system to revert to essentially single channel operation;

(ii) the computed LOTC occurrence rate is greater than 75 occurrences per million hours, but less than 100 occurrences per million hours.

(3) Long Time Dispatch. Long time dispatch configurations require repair within an FAA approved interval (currently defined as a maximum of 500 hours). Long time dispatch configurations are defined as those that do not fall into the no dispatch or short time dispatch categories and where the computed LOTC occurrence rate is less than 75 occurrences per million hours.

(4) Substantiation Data for Dispatch Levels. The statistical analysis report is submitted to the FAA engine Type Certificate Holding Office (TCHO). The report must include a tabulation of the various proposed dispatch configurations that provides the frequency of occurrence of the faults leading to the dispatchable configuration and LOTC rate for dispatch in the degraded configuration. Also, the report must provide a tabulation that gives the category for each fault covered in the analysis. Substantiation for both long and short time dispatch intervals that are proposed must be provided. In addition, substantiation or justification, including rates, exposure times, and other assumptions, must be provided for hazards introduced by the fault(s) that impact engine operability/durability as required in Section 7.b.

Based on a positive review of the analysis and data provided in the report and discussions with the applicant, as required, the TCHO may grant approval for the requested TLD. A "Record of Revisions" page containing a column to show the FAA ACO approval and date of approval should be included in the report. The TCDS of the engine for which the TLD is being authorized is modified to identify the applicable statistical analysis report, e.g., "Report No.xxxx, dated xxxx, or latest FAA approved revision".

(5) Margin. As a guideline, the fleet-wide average LOTC rate analysis should show compliance with the fleet-wide average LOTC rate criterion at a time equal to two times the long time dispatch interval for which the applicant requests approval. This 2:1 margin is provided to cover uncertainties in the analysis. This margin may be modified by the FAA based on evidence from the applicant that the analysis is qualified to predict in-service reliability experience. Field experience reliability data from engine-mounted electronics of similar complexity, along with the statistical analysis, may be used to reduce the required uncertainty margin. The applicant should submit such a request along with data and analysis to the FAA for evaluation and approval. Conversely the FAA may impose a higher uncertainty margin on the applicant's analysis if suitable field experience data is not available.

b. Mature Systems. The dispatch guidelines for mature systems are identical to those stated in paragraphs 12a(1) through 12a(5) above, except for the short and long time intervals and the possible waiver of the margin requirements. For mature systems, the short and long time dispatch intervals are approved by the FAA engine TCHO on a case-by-case basis depending upon the system, analysis, and service experience.

After a FADEC system has accumulated 250,000 hours in-service operation, an applicant may request a change in FADEC system status from entry level to mature level. The applicant must provide data to support the request for change to mature level. The data must demonstrate that the FADEC system has achieved a stable in-service LOTC rate that is consistent with the analysis on which TLD approval is based. Derivatives of similar FADEC systems can be considered to be part of a FADEC family. With FAA approval, the summation of a family of FADEC systems in-service flight operation times can be used in the maturity evaluation.

When a mature FADEC system has accumulated sufficient in-service data to account for uncertainties, the applicant may request that FAA waive/reduce the currently approved uncertainty margin. A stable, acceptable fleet-wide average through six (6) quarterly reporting periods would be considered by the FAA as service data that reasonably accounts for uncertainties in the analysis.

13. MAINTENANCE STRATEGIES. Applicants have proposed the use of TLD in three different maintenance strategies for repairing faults; a repeating maintenance interval, a condition monitored interval and a combination of the repeating and condition monitored intervals. The TLD approach may be used with any of these strategies provided the exposure time with a fault is within the approved dispatch interval. The approved dispatch interval may be determined by a statistical analysis that uses either the full-up or single-fault system model. When evaluating average exposure time, the type of model used in the analysis needs to be considered. Section 8, above, discusses system models.

If the request for approval for a long time dispatch interval is contingent on the use of a particular maintenance strategy (strategies), the statistical analysis report should clearly specify the maintenance strategies allowed. The differences in TLD when applying these strategies are discussed in subsequent paragraphs.

a. Repeating Maintenance Interval. When using this maintenance strategy, all faults are restored to the full-up condition at each scheduled maintenance interval, such as an aircraft letter check. Scheduled maintenance intervals would be an aircraft requirement if they are part of the basis for certification. For this maintenance strategy, the average exposure time with a fault is one-half of the scheduled maintenance interval. This is because a fault could occur at the beginning or end of the interval. Therefore, for long time fault configurations for entry level or mature fleets, the maximum scheduled repeating maintenance interval corresponds to the long time ("Y" value) of Figure l. For short time ("X" value) fault configurations for entry level or mature systems (see Figure l), the repair interval is handled as condition-monitored, with time zero at the time of the fault. Repair cannot be later than the scheduled repeating maintenance interval ("Y" value) or the short time ("X" value), whichever occurs first.

b. Condition Monitored Interval. When using this maintenance strategy, time zero is set at time of the fault and the fault is repaired prior to the end of the condition monitored interval. For this maintenance strategy, the exposure time with a fault is the entire condition monitored interval.

c. Combination Maintenance Interval. It is possible to combine both the repeating maintenance interval and condition monitored maintenance strategies. The applicable guidelines discussed above for these strategies should be applied during those respective parts of the combined maintenance interval. The approved dispatch interval and the associated average fault exposure time shall not be exceeded when the overall combination maintenance interval is considered.

d. Extension of Long Time Dispatch Interval ("Y" value). A temporary extension of the long time dispatch interval ("Y" value) of up to ten (10) percent of the interval, but not to exceed fifty (50) hours may be authorized by the Principle Inspector (PI) to avoid an aircraft-on-ground (AOG) situation. An example of such an unexpected situation would be one where the aircraft may be diverted because of weather and a revenue flight cannot be made back to the maintenance base because time has run out on the long time dispatch interval. The intent of providing this extension is to cover unexpected situations and not to routinely extend the approved interval.

The applicant should provide a statistical analysis that demonstrates that the guidelines defined in this document continue to be met in the event a ten (10) percent extension of the approved long time interval or fifty (50) hours additional, whichever is applicable, is authorized by the PI. In addition, the statistical analysis should show that the uncertainty margin (nominally 2:1) has been preserved. Approval of the statistical analysis that substantiates this extension of the long time dispatch interval (Y-value) should be included in the TCDS along with the baseline TLD approval.

14. SYSTEM REPAIR. It is acceptable to upgrade levels from short time to long time levels on the flight line or intermediate repair stations. This may be accomplished by simply replacing a line replaceable unit (LRU) that corrects the fault. An example is when two faults combine to yield a short time dispatch category ("X" value) and repairing one of the faults results in changing the dispatch category to the long time interval ("Y" value). This flexibility is not intended to relieve the operator from repairing the remaining FADEC fault(s) at the approved interval(s).

15. ENGINE - AIRCRAFT INTERFACE. The data that is supplied via the data bus from the FADEC system to the aircraft provides fault status and dispatch information. This data must satisfy the guidelines for dispatch for both engine and aircraft. The dispatchable configurations and the associated dispatch intervals have been defined in this document on an engine basis. These configuration and dispatch criteria are in accordance with the certification basis for the engine. However, the ACO may impose a more stringent requirement on an aircraft basis than that imposed on an engine basis. The engine dispatch guidelines are not intended to inhibit the imposition of a more rigid dispatch criterion if the ACO determines this is necessary. Therefore, it is incumbent upon the engine and aircraft manufacturers to coordinate with one another to provide a mutually acceptable approach that satisfies both the guidelines defined in this document as well as the aircraft installation issues.

16. FIELD EXPERIENCE. For approval of entry level TLD, the applicant should provide the FAA with reliability data based on at least 125,000 hours of revenue service with related electronic control systems of similar complexity, preferably engine control related experience. Since the statistical analysis does not included quality and manufacturing deficiencies, the FAA allows the applicant to demonstrate capability in these areas through related revenue service experience. The reliability data should demonstrate that the applicant has the capability in the areas of design, quality and manufacturing to support the applicant's statistical analysis. This field experience together with the statistical analysis provide a basis for evaluation by the FAA for approval of entry level TLD.

In the event that an applicant is unable to supply related experience data, this guideline can be fulfilled through a test program approved by the FAA that is designed to accumulate data to demonstrate the reliability of the design, quality and manufacturing processes for the equipment.

17. REPORTING SYSTEM.

a. The applicant must institute a formal, auditable reporting system that will provide periodic reports to the FAA engine TCHO. The reporting system would be a contingency of the TLD approval for the applicant's engine. Currently the reliability performance of the FADEC systems is reported quarterly. The FAA will use the reported data as a means to assure that the in-service reliability of the FADEC is consistent with the analysis upon which the TLD approval is based. Also, the reporting system should provide the FAA with an early warning of component trend failures. The applicant's TLD performance would be reviewed periodically to determine whether the reporting system should be modified. Also, the FAA would determine through the periodic review(s) whether corrective action relating to TLD, such as adjusting dispatch intervals, is required.

b. The reports must include:

(1) A plot of three and twelve-month rolling average of LOTC events per million hours versus accumulated FADEC system hours.

(2) An assessment of the FADEC reliability versus that predicted by the TLD analysis. The assessment should cover the report period, and the entire period since initiation of TLD. The assessment should also consider individual component failure rates, and other assumptions used in the statistical analysis, for continued validity. In addition, the assessment should report any unpredicated component failure modes and effects.

(3) The applicant should inform the FAA engine TCHO, as soon as practicable, of any potential in-service airworthiness concerns resulting from design, manufacturing, quality or maintenance errors which may effect FADEC system operation or reliability. This information should be transmitted to the FAA, even though LOTC rates may not currently be impacted.

c. Items 17b(2) and 17b(3) above of the reporting system may be simplified when a system reaches maturity and when the in-service data has substantiated the accuracy of the system model and the results of the statistical analysis.

d. The reporting system for a given FADEC system would be continued so long as the TLD system is in use, since the factors of concern are not necessarily time dependent.